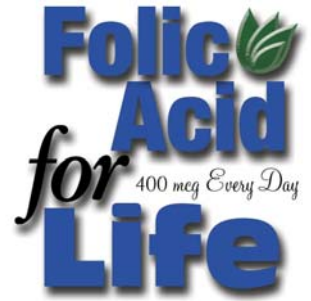




Indiana State
Department of Health



Teacher's Guide

Babies, Birth Defects and Folic Acid: Education in the Classroom

A Lesson Targeted for High School Students

This lesson plan was adapted with permission from the CDC Folic Acid Excite
Module found at <http://www.cdc.gov/ncbddd/folicacid/excite/>

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Indiana State Department of Health

Babies, Birth Defects and Folic Acid: Education in the Classroom

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Lesson 1 (Part A and B)

(Total Estimated time 40 minutes)

Objective: Recognize terms and meanings of neural tube defects.
Increase knowledge of early fetal development.

Materials Needed: Overheads, handouts, two headed zipper (optional), paper and paper clips

Part A: Introduction (Estimated time 20 minutes)

Plan: Part A of this lesson has two components and an optional third component. The two components include the birth defects information (lecture/notes) and the demonstrations. The optional third component is a student activity. It works best to use the demonstrations while discussing the birth defects information.

Information for lecture/notes: Neural Tube Defects (NTDs) are birth defects of the brain and the spinal cord. They occur when the neural tube, which later becomes the brain and the spine and the bones surrounding the brain and the spine, fails to close properly. This happens very early in pregnancy, between the 17th and the 28th day after conception. Often a woman doesn't even know she is pregnant at this time. (It is four to six weeks after the first day of a woman's last menstrual period). After the egg and the sperm unite, cells divide and multiply to form an elongated structure as seen in day 22 (overhead). As development progresses, a groove occurs, and tissue begins to fold over into a tube. A "zippering" effect closes the groove or the tube beginning in the center and going both up and down as seen in day 23 (overhead pg. 6). A defect may occur in the upper or lower portion of the neural tube. If the tube fails to close properly on the upper portion of the neural tube, a brain defect called anencephaly or another called encephalocele occurs (upper arrow on Day 22 overhead). If it fails to close properly along the lower portion, a spinal defect called spina bifida occurs (lower arrow on Day 22 overhead).

In the United States, it is known that 1 of every 1,000 babies is born with a neural tube defect. (This means that on average for every 1,000 babies born, one is born with a NTD). Neural tube defects (NTDs) are most common among Hispanics and least common in African Americans and Asians. Birth defects are also more common in families with low incomes (less money for vitamins, doctor visits) and in females with less than or equal to a 12th grade education (decreased opportunity to hear the message)

Demonstrations:

- 1) Overhead of Day 22 and Day 23 in embryonic development (pg. 6)
- 2) A two-headed zipper (that starts in the middle and closes at both ends) could be used to demonstrate the closing of the neural tube.
- 3) Edges of a piece of paper could be joined lengthwise to form a large tube. Several paper clips could be used to secure the edges together, from the middle toward both ends.

Both 2 and 3 show the closing of the neural tube. If the bottom of the "tube" doesn't close completely it can cause spina bifida. If the top of the "tube" doesn't close it could cause anencephaly.

Activity: Number 3 above also works well as a student activity.

Part B: Birth Defect Vocabulary (Estimated time 20 minutes)

Plan: Part B of this lesson has three components, which include the information (vocabulary words), some demonstrations and an activity. The demonstrations work in conjunction with the vocabulary words and the activity. The activity is completed after introducing the vocabulary words. The handout should be given to the students before you begin.

Vocabulary Words:

Anencephaly (Overhead included)
Embryo
Encephalocele (Overhead included)
Hydrocephalus
Spina Bifida (Overhead included)
Spinal Cord
Neural Tube
Neural Tube Defect

an-en-ceph-a-ly

A fatal birth defect that happens when the neural tube does not fully close at the top. As a result, the skull and brain do not form properly. Babies with anencephaly die before or shortly after birth.

em-bry-o

An unborn baby from the beginning of pregnancy through the first 8 weeks.

en-ceph-a-lo-cele

A birth defect that is often fatal. Part of a baby's skull does not form properly, and part of the brain is outside of the skull. Previously, those babies who did survive had severe physical and mental disabilities. Today, their outcomes are generally better.

Encephalocele and the other rare neural tube defects (such as craniorachischisis) account for approximately 10% of all neural tube defects.

hy-dro-ceph-a-lus

An abnormal amount of fluid in the brain. Approximately 80% of babies born with spina bifida have hydrocephalus.

spi-na bi-fi-da

A birth defect of the backbone and spinal cord that leaves the spinal cord exposed. A person with spina bifida may have problems going to the bathroom because of lack of bowel and bladder control, and usually needs crutches or a wheelchair to get around.

Eighty to 90% of babies with spina bifida survive, and most lead productive lives.

myelomeningocele – A type of spina bifida in which a sac protrudes from the back and contains part of the spinal cord, spinal nerves, and spinal fluid.

Approximately 90% of children with spina bifida have myelomeningocele.

meningocele – A type of spina bifida in which a sac protrudes from the back, containing only spinal fluid, not nerves and spinal cord. This less severe form affects about 10% of children with spina bifida.

spin-al cord

A long tube of nerve tissue inside the bony spinal column, running from the brain down the length of the back. It controls movement and feeling.

neu-ral tube

The tube along the back of an embryo which later becomes the spinal cord and brain.

neu-ral tube de-fect (NTD)

Problems in the growth of the spinal cord and brain in an embryo, when the neural tube doesn't close at the top (anencephaly) or the bottom (spina bifida). The defects occur in the first month of pregnancy, before most women know they are pregnant. About 7 babies are born in the U.S. each day with these birth defects.

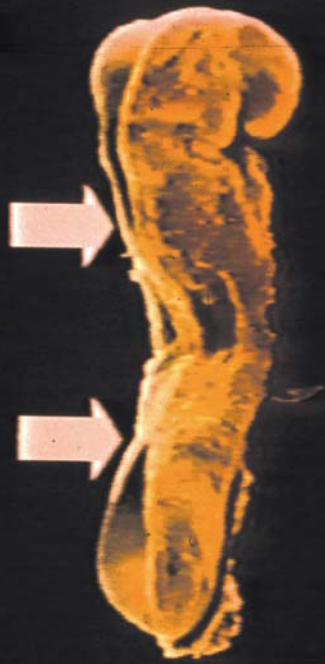
Demonstration:

- 1) You might want to use the vocabulary page to create an overhead (pg. 7).
- 2) Overheads of anencephaly, encephalocele, and spina bifida (pgs 8-10).
- 3) Overhead of blank concept map (pg. 12)

Activity: To reinforce the basic concepts, utilize the birth defects concept map (answer key pg. 11, blank map pg.12). Have students write the vocabulary words in the correct sequence on their own concept maps. Might use the bottom portion of the handout for students to write definitions. They will be able to keep these maps to remind them of vocabulary definitions and to add more information later.

If you do not include this activity in your lesson, you might want to create a handout of the vocabulary words (pg. 7).

DAY 22



Just one day before the neural tube begins to close in a zipper like fashion from the middle toward the end.

DAY 23



The embryo curves and the back portion is rolled into the neural tube. The lower end becomes the spine and the upper end becomes the brain.

Birth Defects Vocabulary

an-en-ceph-a-ly

A fatal birth defect that happens when the neural tube does not fully close at the top. As a result, the skull and brain do not form properly. Babies with anencephaly die before or shortly after birth.

em-bry-o

An unborn baby from the beginning of pregnancy through the first 8 weeks.

en-ceph-a-lo-cele

A birth defect that is often fatal. Part of a baby's skull does not form properly, and part of the brain is outside of the skull. Previously, those babies who did survive had severe physical and mental disabilities. Today, their outcomes are generally better. Encephalocele and the other rare neural tube defects (such as craniorachischisis) account for approximately 10% of all neural tube defects.

hy-dro-ceph-a-lus

An abnormal amount of fluid in the brain. Approximately 80% of babies born with spina bifida have hydrocephalus.

spi-na bi-fi-da

A birth defect of the backbone and spinal cord that leaves the spinal cord exposed. A person with spina bifida may have problems going to the bathroom because of lack of bowel and bladder control, and usually needs crutches or a wheelchair to get around. Eighty to 90% of babies with spina bifida survive, and most lead productive lives.

spin-al cord

A long tube of nerve tissue inside the bony spinal column, running from the brain down the length of the back. It controls movement and feeling.

neu-ral tube

The tube along the back of an embryo which later becomes the spinal cord and brain.

neu-ral tube de-fect (NTD)

Problems in the growth of the spinal cord and brain in an embryo, when the neural tube doesn't close at the top (anencephaly) or the bottom (spina bifida). The defects occur in the first month of pregnancy, before most women know they are pregnant. About 7 babies are born in the U.S. each day with these birth defects.

Anencephaly occurs when the top part of the skull and the brain fail to form properly. Babies with this birth defect are miscarried, stillborn, or die shortly after birth. This birth defect is always fatal.

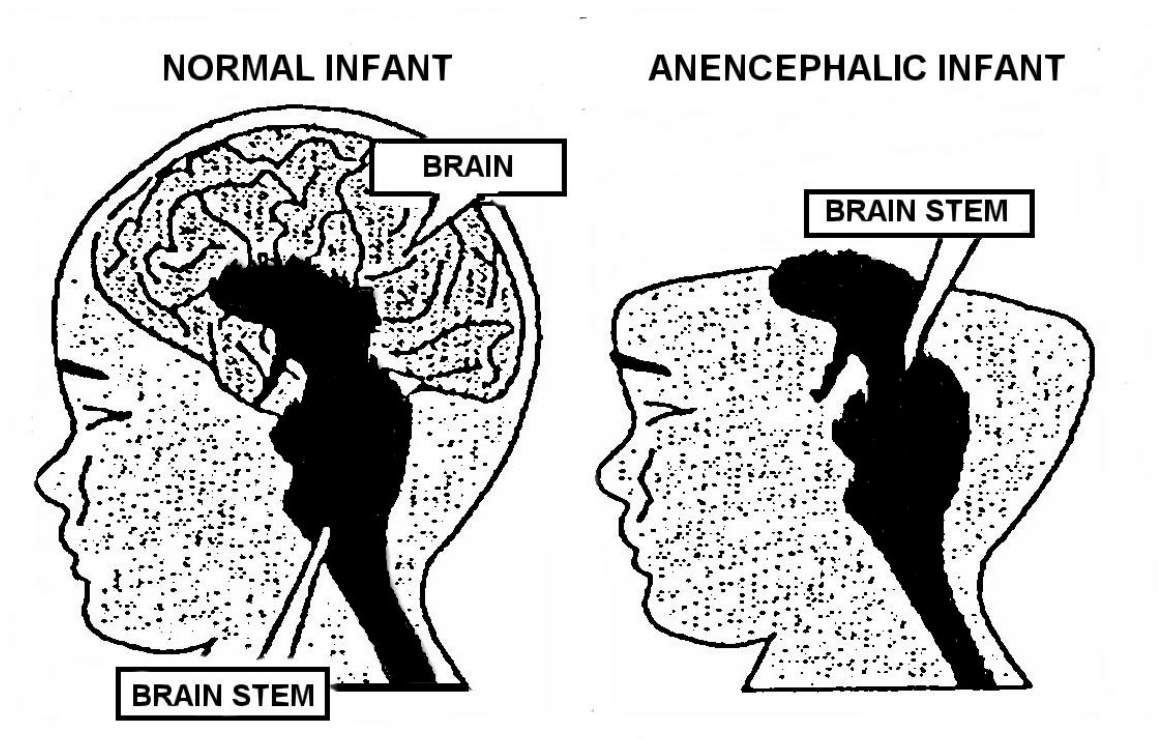


Image from: http://www.asfhelp.com/ASF_files/medical_files/Diagram-Thumbnail.htm

Encephalocele is a more rare form of neural tube defect. It occurs when the skull does not form properly, allowing part of the baby's brain to be outside the skull. Years ago, babies who survived frequently had severe mental and physical disabilities. These days, the outlook is often better.

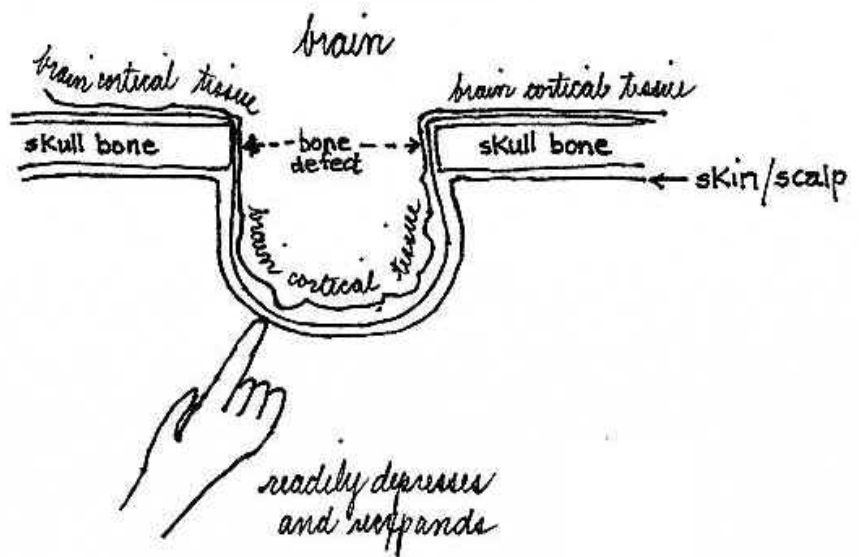


Image from <http://www.uscneurosurgery.com/.../pathology%20encephalocele.htm>

Spina bifida occurs when the spine does not form properly. An opening in the spine causes damage to the lining of the spinal column and frequently to the spinal cord itself. Often there is a sac filled with part of the spinal cord, some spinal nerves, and fluid that forms on the baby's back. The damage that occurs may lead to muscle weakness, paralysis, and loss of bowel and bladder control. Hydrocephalus (water on the brain) also occurs frequently in these babies. Most of these babies grow into adulthood with different degrees of disabilities. Eighty to 90% of babies with spina bifida survive, and most lead productive lives.

Myelomeningocele – A type of spina bifida in which a sac protrudes from the back and contains part of the spinal cord, spinal nerves, and spinal fluid. Approximately 90% of children with spina bifida have myelomeningocele.

Meningocele – A type of spina bifida in which a sac protrudes from the back, containing only spinal fluid, not nerves and spinal cord. This less severe form affects about 10% of children with spina bifida.

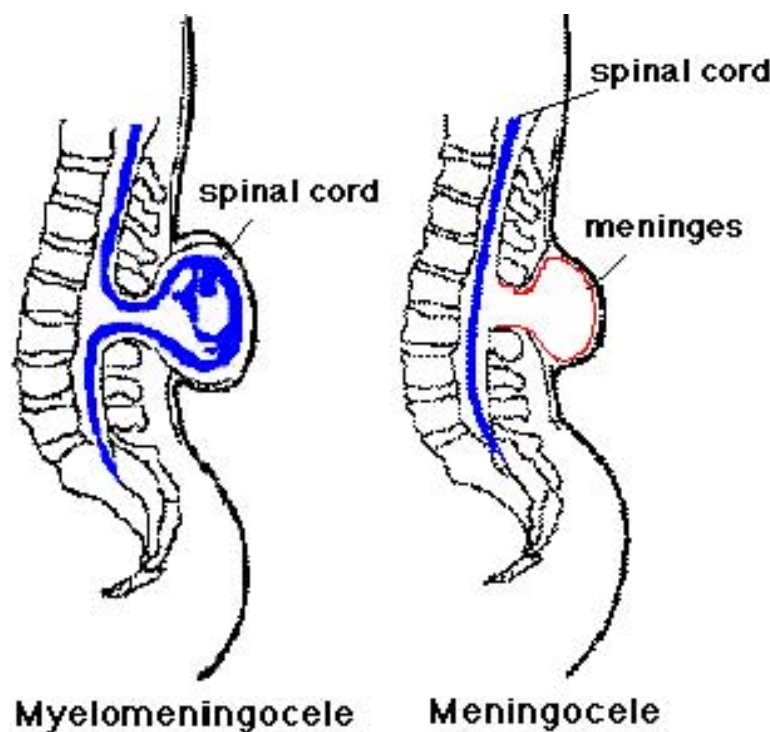
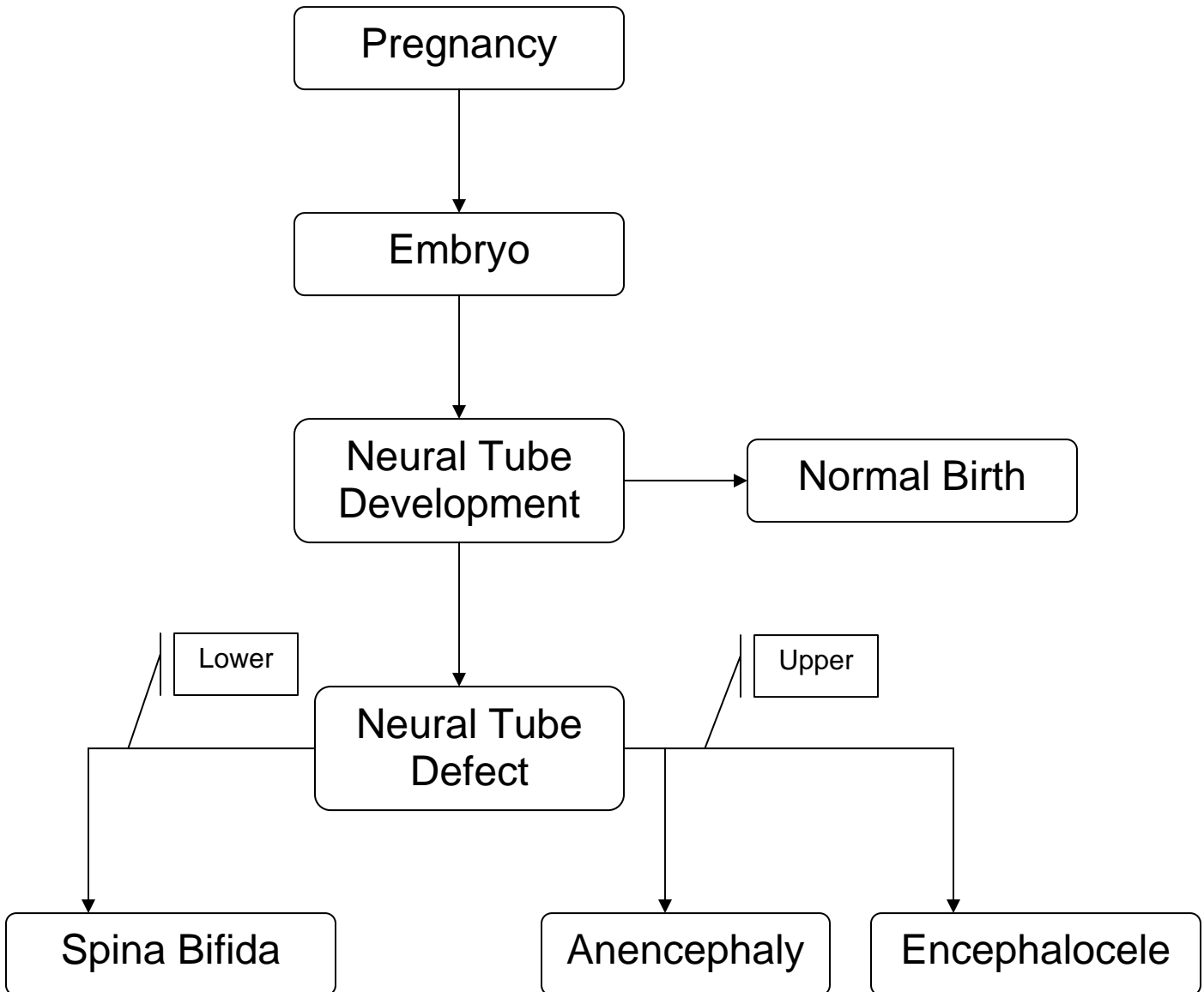


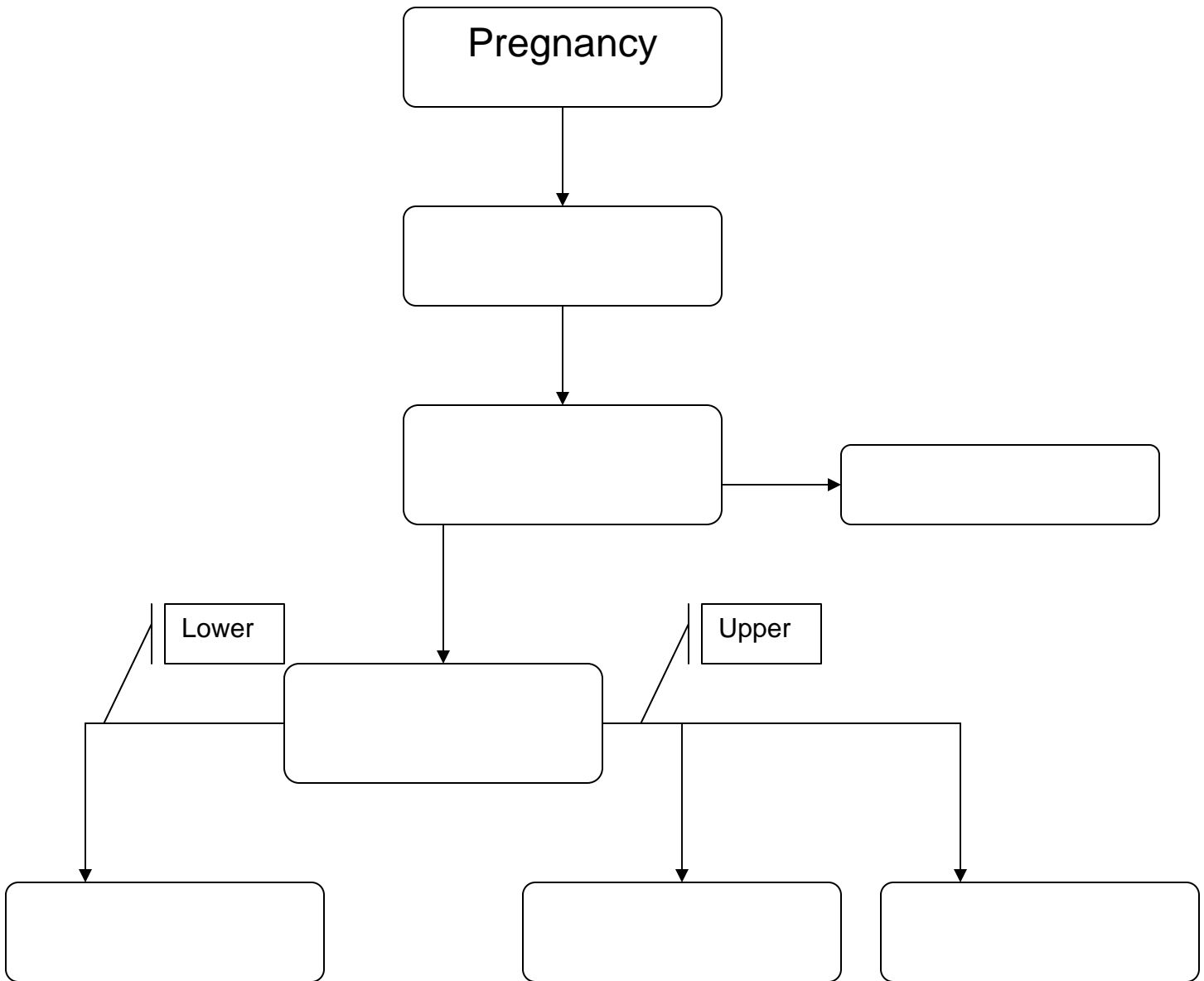
Image from: www.sbacf.org/facts_whatspina.cfm

Concept Map

ANSWER KEY



Concept Map



Fill in the concept map with the following terms:

Anencephaly

Embryo

Encephalocele

Neural Tube Defect

Neural Tube Development

Normal Birth

Spina Bifida

Lesson 2: Folic Acid Information (Estimated time 40 minutes or two 20 minute sessions)

Objectives: Explain who, why and when individuals should take folic acid.
Recognize the link between folic acid, early fetal development and neural tube defects.
Understand that environmental conditions influence embryo development.

Materials Needed: Overheads, handouts

Plan: This plan has three components, which include folic acid information (lecture/notes), a demonstration and activities. The demonstration and activity A go together and should be done after discussing the folic acid information. Activities B and C are optional.

Information: Researchers have found that the B-vitamin, folic acid, can prevent 50-70% of neural tube defects like anencephaly and spina bifida. Folic acid is a water-soluble B-vitamin necessary for DNA synthesis, rapid cell division and embryo development. "Water soluble" means it does not stay in your body for very long, so you need to take it every day. The U.S. Public Health Service recommends that all females who could possibly become pregnant get 400 micrograms (mcg) [or 0.4 milligrams (mg)] of folic acid every day.

[1 Gram = 1,000 milligrams = 1,000,000 micrograms (a microgram is a very, very small amount)]

There are two different forms of folic acid:

Synthetic form. This form is man-made. It is the form of the vitamin that is added to most multivitamin pills and **enriched** or **fortified** grain products, including most cereal, bread, rice, and pasta. Our bodies absorb the synthetic form of folic acid more easily than the natural form (also called folate). About 50 cereals are fortified with 100% (400 mcg) folic acid per serving. (Handout pg. 18)

Fortified means adding nutrients that weren't present originally (for example, man-made folic acid).

Enriched means adding back nutrients that were lost during food processing (for example, natural B vitamins).

Natural form. This form, called folate, is found naturally in foods such as dark-green leafy vegetables (spinach, collard greens, turnip greens, and romaine lettuce), broccoli, asparagus, beans, peanuts, strawberries, kiwi, liver, orange juice, and other food items. A diet rich in folate is important, however the average American diet does not supply enough folic acid. *Source: Institute of Medicine. Report of the Institute of Medicine Food and Nutrition Board, Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Washington, DC: National Academy Press, 1998.*

The average daily intake of folate from foods is about 200 micrograms. Since folate is a more complex form of folic acid, it is not absorbed and used by the body as well as folic acid. It is estimated that only one half of the folate

consumed is usable. So, of the 200 micrograms that are eaten, only about 100 micrograms are actually used by the body. In addition, the folate in foods can also be lost through processing and cooking which reduces the amount of available folate even further. Since it is hard to get enough folate from foods, the Institute of Medicine states that any female who can get pregnant should take 400 micrograms of folic acid everyday from supplements or enriched foods in addition to a healthy, varied diet.

Females least likely to take folic acid daily include:

- Non-whites
- 18-24 years old
- Income less than \$25,000
- No college education

Source: March of Dimes Birth Defects Foundation. Folic acid and the prevention of birth defects: a national survey of pre-pregnancy awareness and behavior among women of childbearing age, 1995--2002. Conducted by the Gallup Organization. White Plains, NY: March of Dimes Foundation, May 2002. Publication no. 31-1677-02.

Fortifying the food supply

Recognizing the importance of folic acid in preventing neural tube defects, the FDA ruled that starting January 1, 1998, all cereals and grain products labeled "enriched" must be fortified with folic acid. These foods were chosen for fortification with folic acid because they are staple products for most of the U.S. population, and because they have a long history of being successful vehicles for improving nutrition to reduce the risk of classic nutrient deficiency diseases. Since fortification began there has been a 31% decrease in spina bifida and a 16% decrease in anencephaly. *Source: US Food and Drug Administration. 21 CFR Parts 136, 137, and 139. Food standards: amendment of standards of identity for enriched grain products to require addition of folic acid. Federal Register 1996; 61:8781-97; Williams et al (2002), Teratology 66:33-39*

Some of the foods that now have extra folic acid include pasta, bread, flour, breakfast cereals, and rice. Still, most females' ages 13-45 years do not get enough folic acid every day. To get enough folic acid through enriched foods every day you would need to eat a whole loaf of bread; or four servings of many cereals; or 3.5 servings of pasta; or 10 servings of rice.

Other Benefits Researchers are looking at other advantages of folic acid besides preventing birth defects. Some researchers believe that folic acid may help prevent some heart attacks, strokes, Alzheimer's disease, and some cancers later in life.

Demonstration: 1) Overheads of blank 'How can we get women to consume more folic acid?' (See Activity A).

Activities:

A) Use the blank form (pg. 17) to create a handout and/or an overhead. You might also choose to use a chalkboard to fill in the blanks.

Could be done as a class or in small groups. Imagine that you and the students/groups in the class are members of the National Council for Nutrition and Health. You are meeting to make sure that all women who could get pregnant receive 400 micrograms of folic acid or folate every day. There are three main options that could be tried.

1. One option is to fortify more foods.
2. A second option is to urge women to consume vitamin pills or fortified cereals that contain the recommended amount.
3. The third option is to try to change the eating habits of women so that they will eat more foods with folic acid and folate.

Complete the chart and discuss the pros and cons of each of the three options. Example discussion topics are provided below. Discuss which options would be better accepted, and if there are costs involved, or education and behavior changes needed.

<i>Option</i>	<i>Pros</i>	<i>Cons</i>
Fortify more foods with folic acid	The body better uses folic acid in fortified foods than food folate	Some people may be concerned about people getting too much
	Effective for people who do not like taking pills, or cannot remember to	Must convince the U.S Food and Drug Administration (FDA) to make changes in food supply rules
	Can be easily incorporated into a daily diet	
Urge all women to take vitamin pills or eat 100% fortified cereals	The body better uses folic acid than food folate	Some women don't like to take vitamin pills
	Folic acid pills cost less than a penny a day	Educational campaign would be needed so more women would take supplements
	About 50 different cereals are enriched with 400mcg folic acid per serving	Educational campaign would be needed to educate public about what cereals contain 400mcg folic acid
Try to have all women improve their eating habits and eat more foods rich in folate	Women will be healthier because most folate rich foods are high in fiber and low in fat	Changing eating habits is very difficult
		The body does not absorb folate as well as it absorbs folic acid (Susceptible to cooking losses also)
		Cannot be used as a single source of folic acid because portions would be very large

The student might have other ideas about the advantages and disadvantages of the three options. If they ask, folic acid is not likely to cause an allergic reaction, is not addictive, and is not toxic. Extra folic acid leaves the body through urine.

- B) Create a plan for 1 day's meals that includes 400 micrograms of folic acid (without eating a cereal with 400 mcg of folic acid per serving). To find the amount of folic acid in foods go to the U. S. Department of Agriculture site at http://www.nal.usda.gov/fnic/cgi-bin/nut_search.pl.
- C) Design an educational poster or newspaper article to tell people about folic acid.
Example topics:
- The importance of folic acid and the development of neural tube defects
 - Teen girls, women of childbearing age, and the need for folic acid
 - Fortification and supplementation of foods with folic acid

Name: _____

How can we get women to consume more folic acid?		
Option	Pros	Cons
Fortify more foods with folic acid		
Get all women to take vitamin pills or to eat 100% fortified cereals		
Have women change their eating habits		

CEREALS THAT CONTAIN 100% OF THE DAILY VALUE (DV) OF FOLIC ACID

The following list of cereals have recently been fortified with 100% of the DV of folic acid.

General Mills Harmony®
General Mills Multi-Grain Cheerios®
General Mills Multi-Grain Cheerios®Plus
General Mills Total® Brown Sugar and Oat
General Mills Total® Corn Flakes
General Mills Total® Raisin Bran
General Mills Total® Whole Grain
Kashi® Heart to Heart
Kellogg's® All-Bran® Original
Kellogg's® All-Bran® with Extra Fiber
Kellogg's® All-Bran® Bran Buds®
Kellogg's® Complete® Oat Bran Flakes
Kellogg's® Complete® Wheat Bran Flakes
Kellogg's® Crispix®
Kellogg's® Healthy Choice™ Almond Crunch with Raisins
Kellogg's® Healthy Choice™ Low-Fat Granola with Raisins
Kellogg's® Healthy Choice™ Low-Fat Granola without Raisins
Kellogg's® Healthy Choice™ Mueslix
Kellogg's® Healthy Choice™ Toasted Brown Sugar Squares
Kellogg's® Just Right® Fruit and Nut
Kellogg's® Product 19®
Kellogg's® Smart Start®
Kellogg's® Special K®
Kellogg's® Special K® Plus™
Nature's Path Organic Optimum Power Breakfast Cereal
Quaker Oats Apple Zaps® (Bagged)
Quaker Oats Cap'n Crunch Red box®
Quaker Oats Cap'n Crunch with Crunch berries®
Quaker Oats Cap'n Crunch's Oops! All Berries®
Quaker Oats Cap'n Crunch's Peanut Butter Crunch®
Quaker Oats Cinnamon Crunch®
Quaker Oats Cocoa Blasts® (Bagged)
Quaker Oats Crispy Corn Puffs® (Bagged)
Quaker Oats Crunchy Corn Bran®
Quaker Oats Frosted Toasted Oats® (Bagged)
Quaker Oats Fruitangy Ohs® (Bagged)
Quaker Oats Fruity Ocean Adventure® (Bagged)
Quaker Oats Honey Dipps® (Bagged)
Quaker Oats Honey Graham OH!s®
Quaker Oats Honey Grahams® (Bagged)
Quaker Oats Honey Nut Oats® (Bagged)
Quaker Oats King Vitamin®
Quaker Oats Life Cereal / Cinnamon Life®
Quaker Oats Marshmallow Safari® (Bagged)
Quaker Oats Oat Bran RTE®
Quaker Oats Oatmeal Squares® - Regular flavor and Cinnamon
Quaker Oats Quisp®
Quaker Oats Sun Country Oats® with Iron
Quaker Oats Sweet Crunch®
Quaker Oats Toasted Oatmeal® - Regular flavor and Honey Nut
Quaker Oats Toasted Oats® (Bagged)

Lesson 3: Case Description and Scientific Investigation (Parts A, B and C) **(Total estimated time 40 minutes)**

Objectives: Increase scientific thinking
Identify risk factors for neural tube defects
Apply basic principles and methods of epidemiology

Materials Needed: Overheads, worksheets

Plan: Part A of this plan has two components with an optional third component. The first two components include the vocabulary words and an activity. The third component is an optional demonstration. Before beginning the lesson **pass out student packet to complete Lesson 3 (pgs. 25-28), which incorporates knowledge obtained from Lessons 1 and 2.**

Part A Vocabulary (Estimated time 10 minutes)

Case. The *occurrence* of a health problem or disease in a person.

Case Definition. A way to describe who has the health problem by place, time and clinical characteristics. For example, researchers defined a case as a baby born in Marion County between October 2002 and November 2002 with a diagnosis of spina bifida.

Cluster. A group of cases, which are, close in time and place. A cluster implies a common cause or source.

Epidemiology. The study of distribution and causes of disease or other health related events in human populations..

Hypothesis. An educated guess made after information is gathered and viewed. Research is done to test whether the hypothesis is true or not.

Retrospective Study. A study that looks at the people who have the disease or defect and tries to determine what characteristics they have that may have contributed to the disease or defect.

Risk Factor. Personal behavior or lifestyle, an environmental exposure, or a family trait that might cause or add to a health problem.

Demonstration:

You might want to use the vocabulary page to create an overhead (pg. 23)

Activity:

To teach the vocabulary you may want to use the vocabulary page to create an overhead. Go over the words and definitions with the class. Have students fill in section 1 of the worksheet.

Part B Case Description (Estimated time 10 minutes)

Plan: Part B of this plan is a continuation of the packet and consists of three components, which include a case description, a demonstration, and activities. These components are done in order with the case discussion first, the demonstration second and the activities third.

Information: Background on Marion County (*Figures have been adapted from the Indiana State Department of Health for demonstration purposes*)

Marion County is in the center of Indiana (overhead pg. 24). It is the largest county in the state. The population is approximately 856,940. Of this number, approx. 4.0% are persons of Hispanic or Latino origin (higher than the state average of 3.5%) and approx. 12% of persons are living below poverty (higher than the state average of 9.5%). There are approximately 13,800 births per year. In 2002, there were 10 reported cases of spina bifida in Marion County Indiana. Five (half) of these cases were reported in a ten-week time period from October to December. Since this is an unusual **cluster**, it got the attention of health workers in the area. The Indiana State Department of Health asked **epidemiologists** to help them look into the problem.

Demonstration (Use this with question 2 of section 4 in the packet):

About 13,800 babies are born per year in Marion County. If the rate of neural tube defects in the U.S. is 1 per 1,000 births, how many of the 13,800 babies born in Marion County in a year would you expect to have an NTD?

Write on the board or an overhead:

$$13,800 \text{ babies} \times \frac{1 \text{ NTD}}{1,000 \text{ births}} = 13.8 \text{ NTD-affected births/year (expected)}$$

Five babies were born with spina bifida in Marion County within 10 weeks in 2002. If these rates continued, how many babies would you expect to be born with spina bifida in Marion County in a **whole year**?

Write on the board or an overhead:

$$\frac{5 \text{ NTDs}}{10 \text{ weeks}} \times \frac{52 \text{ weeks}}{1 \text{ year}} = 28 \text{ NTD-affected births/year (projected)}$$

Activity:

- 1) Read (individually or as a class) the case study in section 2 of the packet.
- 2) As a class or in small groups have the students brainstorm a list of **risk factors** for the neural tube birth defects. Using section 3 in the packet, have individuals/group members write the factors they think could have occurred, then discuss these ideas.

Part C Scientific Method (Estimated time 20 minutes)

Plan: Part C of this lesson is a continuation of the packet and consists of two components, which include a short overview of the scientific method and an activity. The two components are used simultaneously.

Information: Epidemiologists begin studies with a complete version of the scientific method. Below are the 10 steps they use to conduct an investigation. In real life, several steps may be done at the same time, or in a different order.

- | | |
|--|---|
| 1. Prepare for field work | 6. Make hypotheses |
| 2. Show that an outbreak exists | 7. Test hypotheses |
| 3. Confirm the diagnosis | 8. Refine hypotheses and carry out more studies |
| 4. Define and find cases | 9. Begin control and prevention measures |
| 5. Describe and line up the data in terms of person, place, and time | 10. Share findings |

Activity:

Students may work on this individually or by dividing the students into groups of 3 or 4. Using the **scientific method**, have the individuals/groups read through the steps and then complete the questions in section 4 of the packet (answer key pgs. 29 to 31). Then have individuals/group members discuss their plans with the class.

1. How would you begin to prepare for this fieldwork investigation?
2. How would you show that an outbreak exists? How could you confirm this? (Use demonstration above)
3. State the Case Definition:
4. How would you go about finding cases?
5. What would be your educated guess (hypothesis) of the cause of the problem for this case study?
6. Based on your hypothesis, what do you predict you will find when you test your hypothesis?
7. How will you test your hypothesis? (make sure you are creating a retrospective study)
8. If your hypothesis is correct, what would your results look like?
9. How would you evaluate your results?
10. If your results were incorrect what would you do?

11. Once you have determined the problem what would you do to begin control and prevention measures?

12. Who would you report your results to?

Vocabulary

Case. The *occurrence* of a health problem or disease in a person.

Case Definition. A way to describe who has the health problem by place, time and clinical characteristics. For example, researchers defined a case as a baby born in Marion County between October 2002 to December 2002 with a diagnosis of spina bifida.

Cluster. A group of cases, which are, close in time and place. A cluster implies a common cause or source.

Epidemiology. The study of distribution and causes of disease or other health related events in human populations.

Hypothesis. An educated guess made after information is gathered and viewed. Research is done to test whether the hypothesis is true or not.

Retrospective Study. A study that looks at the people who have the disease or defect and tries to determine what characteristics they have that may have contributed to the disease or defect.

Risk Factor. Personal behavior or lifestyle, an environmental exposure, or a family trait that might cause or add to a health problem.

Indiana State Map by County



Name: _____

Birth Defect Investigation Worksheet

I. Before beginning activity define the following terms:

1. Case:
2. Case Definition:
3. Cluster:
4. Epidemiology:
5. Hypothesis:
6. Retrospective Study
7. Risk Factor:

II. Read the following Case Description:

Marion County is in the center of Indiana. It is the largest county in the state. The population is approximately 856,940. Of this number, approx. 4.0% are persons of Hispanic or Latino origin (higher than the state average of 3.5%) and approx. 12% of persons are living below poverty (higher than the state average of 9.5%). There are approximately 13,800 births per year. In 2002, there were 10 reported cases of spina bifida in Marion County Indiana. Five (half) of these cases were reported in a ten-week time period in October to December. Since this is an unusual **cluster**, it got the attention of health workers in the area. The Indiana State Department of Health asked **epidemiologists** to help them look into the problem.

III. Make a list of risk factors for the neural tube birth defects:

IV. Below you will find the 10 steps of the scientific method used by Epidemiologists to conduct investigations. In real life, several steps may be done at the same time or a different order. Read through the steps carefully and then complete the questions that follow:

- | | |
|--|---|
| 1. Prepare for field work | 6. Make hypotheses |
| 2. Show that an outbreak exists | 7. Test hypotheses |
| 3. Confirm the diagnosis | 8. Refine hypotheses and carry out more studies |
| 4. Define and find cases | 9. Begin control and prevention measures |
| 5. Describe and line up the data in terms of person, place, and time | 10. Share findings |

1. How would you begin to prepare for this fieldwork investigation?

2. How would you show that an outbreak exists? How could you confirm this?

3. State the Case Definition:

4. How would you go about finding cases?

5. What would be your educated guess (hypothesis) of the cause of the problem for this study?

6. Based on your hypothesis, what do you predict you will find when you test your hypothesis?

7. How will you test your hypothesis? (make sure you are creating a retrospective study)

8. If your hypothesis is correct, what would your results look like?

9. How would you evaluate your results?

10. If your results are incorrect what would you do?

11. Once you have determined the problem what would you do to begin control and prevention measures?

12. Who would you report your results to?

Name: _____

ANSWER KEY

Birth Defect Investigation Worksheet

I. Definitions

1. **Case:** The *occurrence* of a health problem or disease in a person.
2. **Case Definition:** A way to describe who has the health problem by place, time and clinical characteristics.
3. **Cluster:** A group of cases close in time and place. A cluster implies a common cause or source.
4. **Epidemiology:** The study of distribution and causes of disease and other health related events in human populations.
5. **Hypothesis:** An educated guess made after information is gathered and viewed. Research is done to test whether the hypothesis is true or not.
6. **Retrospective Study.** A study that looks at the people who have the disease or defect and tries to determine what characteristics they have that may have contributed to the disease or defect. *For example, if we found 100 women who had babies with a birth defect and asked them questions about the types of food they ate, or where they worked, this would be an example of a retrospective study.*
7. **Risk Factor:** Personal behavior or lifestyle, an environmental exposure, or a family trait that might cause or add to a health problem.

II. Read the following Case Description:

Marion County is in the center of Indiana. It is the largest county in the state. The population is approximately 856,940. Of this number, approx. 4.0% are persons of Hispanic or Latino origin (higher than the state average of 3.5%) and approx. 12% of persons are living below poverty (higher than the state average of 9.5%). There are approximately 13,800 births per year. In 2002, there were 10 reported cases of spina bifida in Marion County Indiana. Five (half) of these cases were reported in a ten-week time period in October to December. Since this is an unusual **cluster**, it got the attention of health workers in the area. The Indiana State Department of Health asked **epidemiologists** to help them look into the problem.

III. Make a list of risk factors for the neural tube birth defects:
Examples of appropriate answers: Hispanic, young female (18-24 years old), low income, no college education.

IV. Below you will find the 10 steps of the scientific method used by Epidemiologists to conduct investigations. In real life, several steps may be done at the same time or a different order. Read through the steps carefully and then complete the questions that follow:

- | | |
|--|---|
| 1. Prepare for field work | 6. Make hypotheses |
| 2. Show that an outbreak exists | 7. Test hypotheses |
| 3. Confirm the diagnosis | 8. Refine hypotheses and carry out more studies |
| 4. Define and find cases | 9. Begin control and prevention measures |
| 5. Describe and line up the data in terms of person, place, and time | 10. Share findings |

1. How would you begin to prepare for this fieldwork investigation?

First prepare a list of questions that may help in the investigation. (You may also have students write the questions that they would ask or seek answers to during the investigation). Gather study supplies like a laptop computer, lab equipment, a map and list of places to go, and a notebook. Make reservations for the trip and make a plan for whom to meet and what to do once you arrive. *Answers will vary.*

2. How would you show that an outbreak exists? How could you confirm this?

An outbreak occurs when there are more cases of a certain disease than expected. To know if an outbreak exists; we need to know if the number of cases is above what is expected. In the U.S., the rate of NTDs is 1 per 1000 babies. This means that on average for every 1,000 babies born, one is born with an NTD.

3. State the Case Definition:

Answers may vary slightly. For example, researchers defined a case as a baby born in Marion County between October 2002 and November 2002 with a diagnosis of spina bifida.

4. How would you go about finding cases?

Example of appropriate answers: Hospital medical records, birth and death certificates, state health departments, doctors' files, and/or clinic records.

5. What would be your educated guess (hypothesis) of the cause of the problem for this case study?

Answers may vary slightly. Example of appropriate answer: Persons living below poverty have a greater chance of having a baby born with spina bifida.

6. Based on your hypothesis, what do you predict you will find when you test your hypothesis?

Answers may vary. Example of appropriate answer: Based on hypothesis I would expect to find a greater percentage of babies born with spina bifida to mothers who did not take folic acid due to low income and/or low accessibility.

7. How will you test your hypothesis? (Make sure you are creating a retrospective study)

Answers may vary. Example of appropriate answer: Interview the women who had babies born with spina bifida and ask them questions about their income level, education level, folic acid knowledge, food intake, age, ethnicity etc.

8. If your hypothesis is correct, what would your results look like?

Answers may vary. Example of appropriate answer: If hypothesis is correct a greater percentage of babies would be born with spina bifida to those mothers with low income levels and/or low accessibility to folic acid.

9. How would you evaluate your results?

Answers may vary. Example of appropriate answer: Results can be evaluated by statistical analysis, using computer programs and reviewed by peers in the scientific community.

10. If your results were incorrect what would you do?

Answers may vary. Example of appropriate answers: If results are incorrect a possible solution is to adjust the hypothesis and redo the experiment based on the new hypothesis.

11. Once you have determined the problem what would you do to begin control and prevention measures?

Answers may vary. Example of appropriate answers: Contact local and state health departments to share your findings, design a program to educate communities, publish your results in a peer-reviewed journal to get the word out to health care professionals, etc...

12. Who would you report your results to?

Answers may vary. Example of appropriate answers: State and local health officials, universities, federal government, peer-reviewed journal articles, legislators, etc....

Name: _____

Summary Quiz:

1) Folic acid is:

- a. A protein
- b. A mineral
- c. A B-vitamin
- d. High in fat

2) How much folic acid should a teen girl or woman who could get pregnant take?

- a. 40 (mcg) micrograms of folic acid daily
- b. 400 (mcg) micrograms of folic acid daily
- c. 4000 (mcg) micrograms of folic acid daily
- d. Other
- e. Don't know/unsure

3) What are some good sources of folic acid (CIRCLE ALL THAT APPLY):

- a. Red meat
- b. Orange juice
- c. Dairy products
- d. Enriched grain products (cereals, breads)
- e. Green leafy vegetables
- f. Multivitamins

4) A neural tube defect develops in the:

- a. Eyes and ears
- b. Arms and legs
- c. Brain and spine
- d. Other

5) The neural tube defects happen:

- a. During the first month of pregnancy
- b. After the second month of pregnancy
- c. In the last months of pregnancy
- d. When the baby is born

6) **A person with spina bifida may have:**

- a. Hydrocephalus
- b. Problems going to the bathroom
- c. Paralysis of the legs
- d. All of the above

7) **The best time for a woman to take folic acid is:**

- a. During her childbearing years and before she gets pregnant and early in pregnancy
- b. After she finds out she is pregnant
- c. After she delivers the baby
- d. Never

8) **Most teen girls and women get enough folic acid in their normal diet.**

- a. True
- b. False
- c. Don't know/unsure

9) **Folic acid in vitamins is easier for the body to use than folate in foods.**

- a. True
- b. False
- c. Don't know/unsure

11) _____ **are most at risk of having an NTD-affected pregnancy.**

- a) Asians or Pacific Islanders
- b) Blacks
- c) Whites
- d) Hispanics

12) **Folic acid is necessary for:**

- a) DNA synthesis
- b) Rapid cell division
- c) Embryo development
- d) All of the above

Name: _____

ANSWER KEY

Summary Quiz:

1) **Folic acid is:**

- a. A protein
- b. A mineral
- c. A B-vitamin**
- d. High in fat

2) **How much folic acid should a teen girl or woman who could get pregnant take?**

- a. 40 (mcg) micrograms of folic acid daily
- b. 400 (mcg) micrograms of folic acid daily**
- c. 4000 (mcg) micrograms of folic acid daily
- d. Other
- e. Don't know/unsure

3) **What are some good sources of synthetic folic acid (CIRCLE ALL THAT APPLY):**

- a. Red meat
- b. *Orange juice (good source of folate)*
- c. Dairy products
- d. Enriched grain products (cereals, breads)**
- e. *Green leafy vegetables (good source of folate)*
- f. Multivitamins**

4) **A neural tube defect develops in the:**

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- b. Arms and legs
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- b. False**
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- b) Rapid cell division
- c) Embryo development
- d) All of the above**

Additional Activity Suggestions:

Below are some ideas of more activities that could be used as extra credit activities, as homework assignments, or as assignments in other classes at school.

- Search the library or the Internet (see Related Sites page) to learn more about new folic acid research. Key words could include folic acid and homocysteine, colon cancer, or Alzheimer's disease.
- Write a paragraph about how you will help your family members remember to take a vitamin every day.
- Research and write an essay about the day in the life of someone with spina bifida.
- Write a letter to a friend who could become pregnant and tell her about folic acid.
- Write a letter to the editor or an article for a school newspaper or local paper to tell people about folic acid.
- Take a survey in your class about how many people take vitamins every day and how much folic acid is in the vitamins they take.
- Make a collage of pictures of good sources of folic acid and/or folate.
- Create a pamphlet about folic acid, why it is needed, and how to get enough of it.
- Bring in one article/advertisement mentioning folic acid in the press.
- Look in cabinets at home to find 10 food items that are enriched with folic acid. Make a list and bring the list to class. Using these lists:
 - Create a plan for 1 day's meals that includes 400 micrograms of folic acid (without eating a cereal with 400 mcg of folic acid per serving).
 - Of the 10 food items found at home, calculate how many items/serving of that particular item would be needed to get 400 micrograms of folic acid a day. For example, how many slices of bread would be needed for 400 micrograms of folic acid?
- Bring in labels of foods containing folic acid or bring in foods that contain folate or folic acid.
- Go to three pharmacies.
 - Look for pill bottles that have only folic acid. How much folic acid is in each pill?
 - Look for multivitamin pills with folic acid. Can you find at least four brands? How much folic acid is in each vitamin pill?

Birth Defects Related Sites:

Organizations

March of Dimes: www.modimes.org

Spina Bifida Association of America: www.sbaa.org

National Birth Defects Prevention Network: www.nbdpn.org

More information about folic acid and NTDs

CDC's Birth Defects Prevention Site: www.cdc.gov/ncbddd/folicacid

Information on other birth defects

CDC's Birth Defects Prevention Site: www.cdc.gov/ncbddd/bd

CDC's Fetal Alcohol Syndrome Site: www.cdc.gov/ncbddd/fas/

National Organization on Fetal Alcohol Syndrome: www.nofas.org